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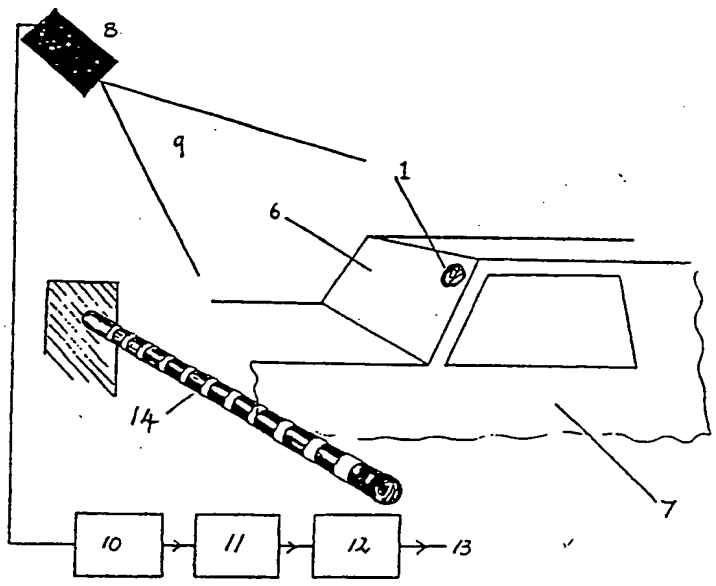
(54) Title: IMAGE PROCESSED OPTICAL TOLL GATE VOUCHER



(57) Abstract

A toll gate system consists of a voucher (1), at least one camera (8) and a neural network computer (11) to control the activation of a toll bar (14). Preferably, the voucher (1) is mounted on the windscreen (6) of vehicle (7). The output of camera (8), which surveys the voucher (1) within its field of view (9), is fed into the neural computer (11) through multiplexer (10). The computer (11) controls a recorder (12) which records the passage of the voucher (1) through the toll gate and activates the toll bar (14) as required. Users of the toll gate may either pre-purchase a voucher (1) for a number of passes through the toll gate, or be billed at a later time.

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Image Processed Optical Toll Gate Voucher

Field of the Invention

This invention relates to an optically identifiable voucher system for the activation of toll gates so as to speed up traffic flow and reduce the number of manned booths required on toll ways, said system consisting of a voucher whose front surface is clearly marked with symbols, letters and numbers, a camera with which to view said voucher carried by a potential toll gate user, a computer with which to recognise the detected symbols, letters and numbers characterising said voucher, said computer controlling both a recorder which records the passage of said voucher through said toll gate and activates said toll gate as required.

The invention may be installed on roadways, entrances to sport arenas, car parks, entrances to railway stations, airports and shipping terminals, in warehouses and public buildings. The said voucher may be displayed in a prominent position on vehicles or be hand held, and may be of different sizes for a given optically detectable pattern. The same voucher can be used to enter toll gates of different types at any location where toll ways are in use. The vouchers, if pre paid can qualify the purchaser to a given number of toll gate passages at a discount or each passage may be post paid. If an identifiable vehicle passes along a toll way fitted with said invention but does not display said voucher then said illegal toll way user would pay a post dated premium or be barred from using said toll way and directed to a manned pay booth. Due to social liberty arguments, a choice of personalised and non-personalised vouchers

can be made available, the latter being pre paid and all legal toll gate passages not been recorded, by law, so that no check could be made regarding the identity of a particular toll gate user at a particular time at a particular place.

Summary of the Prior Art

Prior art toll gates involved manned booths which either received the toll directly from the user during each passage or indirectly via the user depositing coins or inserting pass-cards into the toll control system to allow access. In addition to being time consuming with a tendency to result in severe traffic congestion, particularly at busy toll gates, prior art toll gates were difficult and expensive to monitor as far as the failure of users to pay the toll was concerned, a situation which led to heavy, and often uneconomical staffing level requirements. Radio controlled prior art toll gate suffered from inferference effects and were of very limited information bandwidth which was incapable of visually identifying the toll gate user.

The present invention overcomes the defects of prior art systems in that it visually identifies both users of toll gates who possess toll gate vouchers and those who do not possess such vouchers. Once the toll gate voucher has been identified, the toll gate user is allowed through the said toll gate with no further action. However, if no toll gate voucher is detected then the potential user of the toll gate is either prevented from passing through the toll gate and is directed out of the traffic lane, or the user is identified via, for example, a motor vehicle, number plate and charged at a later

date or, if a lapsed voucher is detected, the user is allowed through with a penalty to be paid at a later date which may be less severe than would be the case where no voucher was detected at all.

Background of the Invention

A need existed for a toll way system where the user could pass through a toll gate without reducing speed yet the passage through said toll gate being recorded and charged to the identified user. To obtain a discounted passage through any toll gate the user would either have to pre pay for an identification voucher or would have to be a regular user of such toll ways.

With the advent of neural network computers, optical image processing has become a topical art because a computer can now be used to more easily identify an optical image. The neural computer based system has only to be taught how to recognise particular patterns with no need for complex software as is required for expert systems. Furthermore, neural network computers do not suffer from computer viruses.

However, with the ability of modern computer based systems to identify users of toll gates at any time and in any place, the question of the social issues involved comes to the fore because of the potential to miss-use the technology. This implies that it may become illegal for any authority to recognise a motor vehicle number plate, for example, during any legal passage through any toll gate, hence the need for pre paid, non-personalised vouchers where only the number of passages through a set of toll gates is recorded with no record being kept of the toll gate user. However, if the voucher is

invalid or if no voucher is displayed, then the system must either bar entry or identify the intruder. In the case of the motor vehicle, the number plates of said vehicles can be recognised and the illegal toll gate user billed at a later date.

Summary of the Invention

It is an object of the invention to provide an optical identifiable voucher which can be presented in the field of view of a surveillance camera mounted on a toll gate, whose image output can be processed by a computer to record the passage of said voucher through said toll gate without interfering with the motion of said voucher in any way.

Another object of the invention is to provide an optically identifiable, pre paid voucher for use by toll way users so that said toll way user obtains substantial discounts on the toll gate levies. It is an object of the invention to provide a method of optically identifying a toll way user possessing a voucher from one who does not possess such a voucher so that the latter is forced to pay for entry through the toll gate at a premium.

Another object of the invention is to provide one voucher for a range of different toll ways.

Another object of the invention is to provide a means of optically identifying the passage of a non voucher carrier through toll gates by the optical recognition of a vehicle and its registration number.

It is an object of the invention to provide non personalised pre paid vouchers so that users can obtain discounts for toll gate passages without being to be identified.

It is also an object of the invention to provide personalised vouchers so that identified users of toll ways can be billed at a later date.

It is an object of the invention to provide eye safe illumination for enhancing the optical clarity of the voucher both at night and under bad weather conditions.

Brief Description of the Drawings

A better understanding of the invention may be obtained from the following considerations taken in conjunction with the accompanying drawings which are not meant to limit the scope of the invention in any way.

Figure 1 shows a configuration of the toll gate voucher of the invention which can be attached to any vehicle in a position that it can be imaged by a surveillance camera or be hand held and displayed to such a camera. This toll gate voucher has optically distinctive marking including symbols, letters and numbers which can be recognised by the invention. Where the markings on said toll voucher have to be enhanced, said markings can be made optically fluorescent or can be optically enhanced at specific wavelengths by illumination with selected eye safe lights under all weather and poor lighting conditions.

Figure 2 shows the layout of the computer based optical image processing system used to read symbols on said toll voucher in real time so as to activate or not activate a toll gate blocking the pathway of a vehicle.

Figure 3 shows a hand held voucher of the invention being displayed to a surveillance camera mounted on a walk through toll gate.

Figure 4 shows the method used to identify a vehicle imaging a toll way which does not possess a valid voucher or no voucher at all, said identification being such so as not to hinder the flow of traffic.

Figure 5 shows the use of an eye safe laser to illuminate voucher 1.

Detailed Description of the Invention

In Figure 1, numeral 1 indicates the toll gate voucher. Numeral 2 indicates optically distinctive markings on voucher 1 to enhance the optical image processing capability of the invention. Numeral 3 indicates another optically distinct marking on 1 which identifies it clearly as a toll gate voucher. Numeral 4 indicates a series of letters and numbers which allow the holder of the toll gate voucher to be cleared or identified by the optical image processing capabilities of the present invention. Numeral 5 indicates the period during which the voucher 1 remains valid.

In Figure 2, voucher 1 is shown attached to a windscreen indicated by numeral 6 of a vehicle indicated by numeral 7. The surveillance camera, indicated by numeral 8, has a field of view indicated by numeral 9 which allows voucher 1 to be identified by the image data supplied by 8 and the image processing system into which it is connected indicated by numerals 10, 11 and 12 respectively, 10 being the multiplexing unit which feeds one or more camera inputs into computer 11 whose outputs in turn activate the recording unit

12. Computer 11 is also connected to an external data base along the link indicated by numeral 13 which connects the invention to a central processing station. Recording unit 12 records the passage of voucher holders and can prevent the passage of non-voucher holders by directing them off the automatic tollway or by identifying their vehicles and billing them at a later time.

In Figure 2, numeral 14 indicates a toll gate bar which lifts out of the way of the approved voucher holder. Toll bar 14 may take the form of any device which can deter a would be offender from proceeding along the tollway without indirectly upsetting the flow of traffic. It is assumed that the entrance to the automatic toll gate on which the invention is mounted will adequately display warnings to non-voucher holders and be adequately illuminated at whatever optical wavelength or range of optical wavelengths to allow the surveillance camera to operate.

In Figure 3, numeral 15 indicates the voucher holders' hand displaying voucher 1 to the invention.

In Figure 4, numeral 16 indicates a motor vehicle approaching a toll gate without a valid voucher or with no voucher at all. Cameras 8 survey the vehicle 16 within their fields of view 9. Information gathered by cameras 9 will then be processed by the invention to identify the type of vehicle involved, its registration number as displayed on its number plates indicated by numerals 17 as well as its colour scheme. This information will be recorded in recording unit 12 and details passed on to the central records office via link 13.

In Figure 5, numeral 18 indicates the eye safe laser illumination.

The invention has applications for the automatic collection of tolls without interfering with traffic flow under heavy traffic conditions. The invention allows for one or more toll gate fees to be pre paid at a discount where appropriate via the sale of toll vouchers through standard commercial outlets including the local shops. This mode of selling pre paid vouchers provides the toll gate owners with up front cash as well as minimising the need for manned toll gates.

Under bad weather conditions, or under poor illumination of the toll gate entrance, for example, at night or in misty and foggy weather, the invention provides for a source of illumination light which can enhance the image of the voucher via fluorescence at particular wavelengths to which cameras 8 are sensitive. The illuminators 18 can be eye safe laser beam generators.

It should be noted that a single voucher, which may be duplicated, will allow tollway users to access a wide range of tollways, parking stations, football stands, and ports, a particular tollway as well as the number of times the owner of the toll voucher uses said tollways during their period of validity.

I claim,

1. An automatic system for optically identifying markings, letters and numbers on a voucher which, when displayed in the field of view of a surveillance camera initiates an image processing sequence where the output of the said surveillance camera is fed into a neural network computer which has been taught to recognise the toll gate voucher's patterns, letters and numbers thus identifying the voucher holder and recording the passage through the toll gate accordingly, said system consisting of a voucher, a surveillance camera, a multiplexing unit to connect more than one camera, a neural computer system which has been taught to recognise said vouchers, a recording unit, a link to a processing centre, a toll gate activation unit, and an eye safe source of illumination which can enhance the optical markings on said voucher during night operation and under poor visibility.

2. A system as claimed in Claim 1 where the voucher does not identify its owner.

3. A system as claimed in Claim 1 where the voucher is pre paid for a number of discounted passes through toll gates fitted with the invention.

4. A system as claimed in Claim 1 in which the vehicle displaying an invalid voucher is identified in terms of registration number as displayed on number plates.

5. A system as claimed in Claim 1 in which the vehicle displaying an invalid voucher is identified via its type, shape, manufacture and colour.

6. A system as described in Claim 1 in which the holder of the voucher is identified prior to accessing the toll gate.

7. A system as claimed in Claim 1 where the voucher is mounted on the top of a motor vehicle and illuminated from above with an eye safe laser light so as to enhance the optical image of said voucher at optical wavelengths corresponding to narrow band filters mounted in the surveillance cameras.

8. A system as claimed in Claim 1 which is capable of identifying a voucher passing through the toll gate at the set speed limit of the tollway.

9. A system as claimed in Claim 1 for identifying moving vehicles along tollways, in ports or air fields and in car parks.

10. A system as claimed in Claim 1 for identifying individual voucher holders entering sports arenas and public buildings.

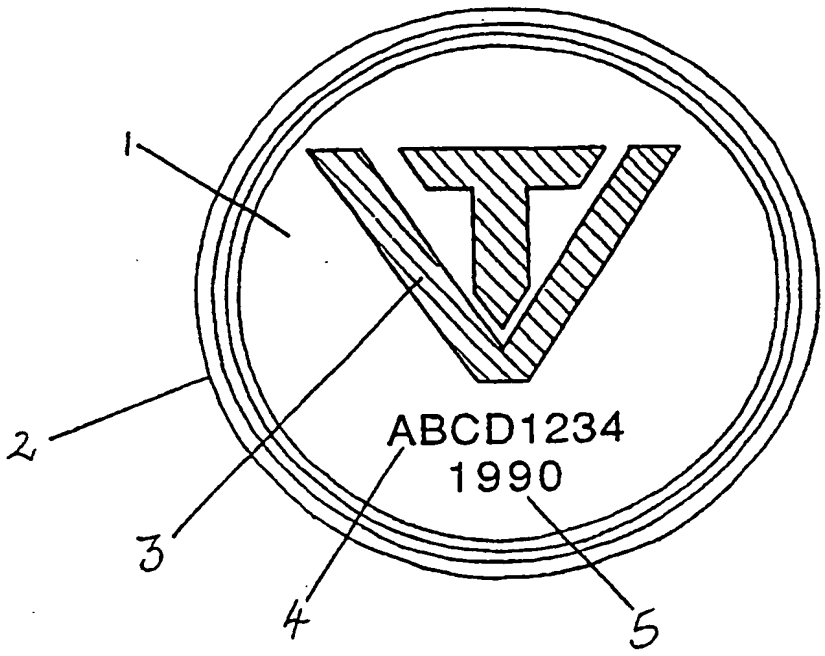

Figure 1

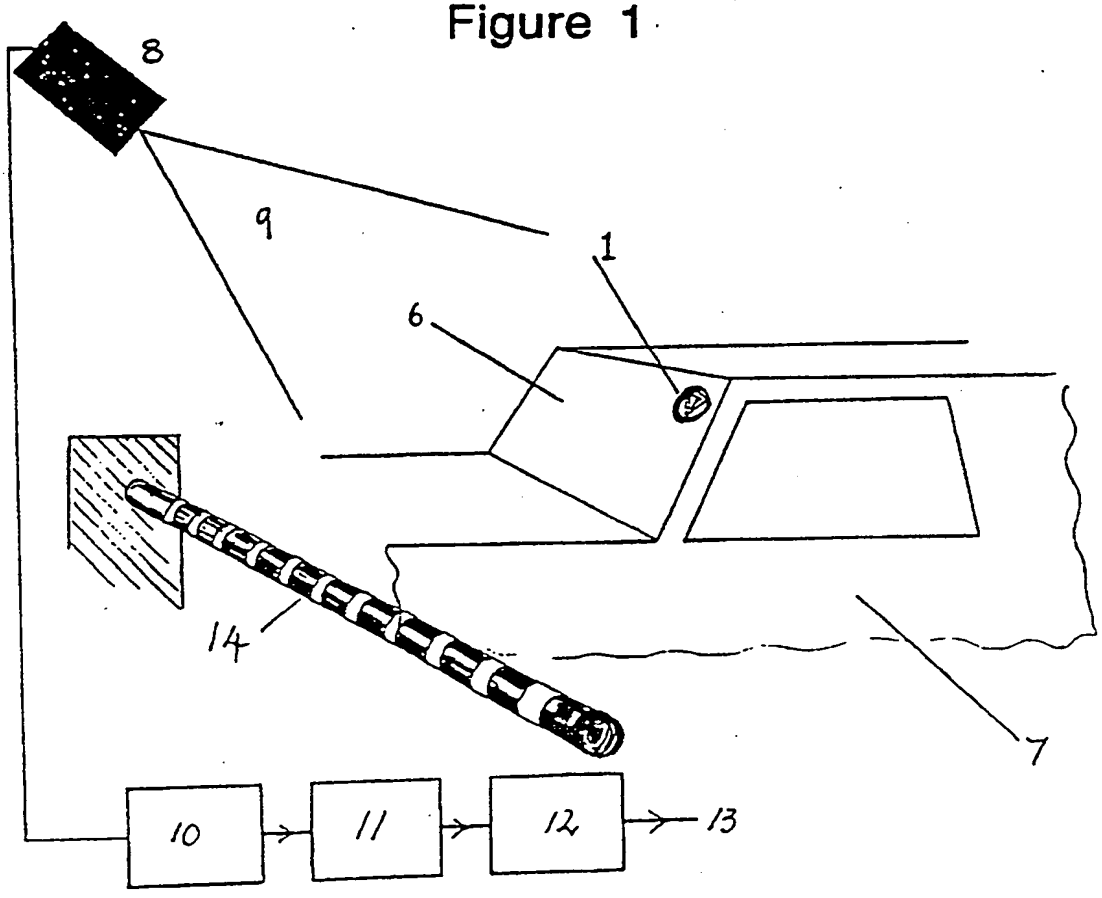

Figure 2

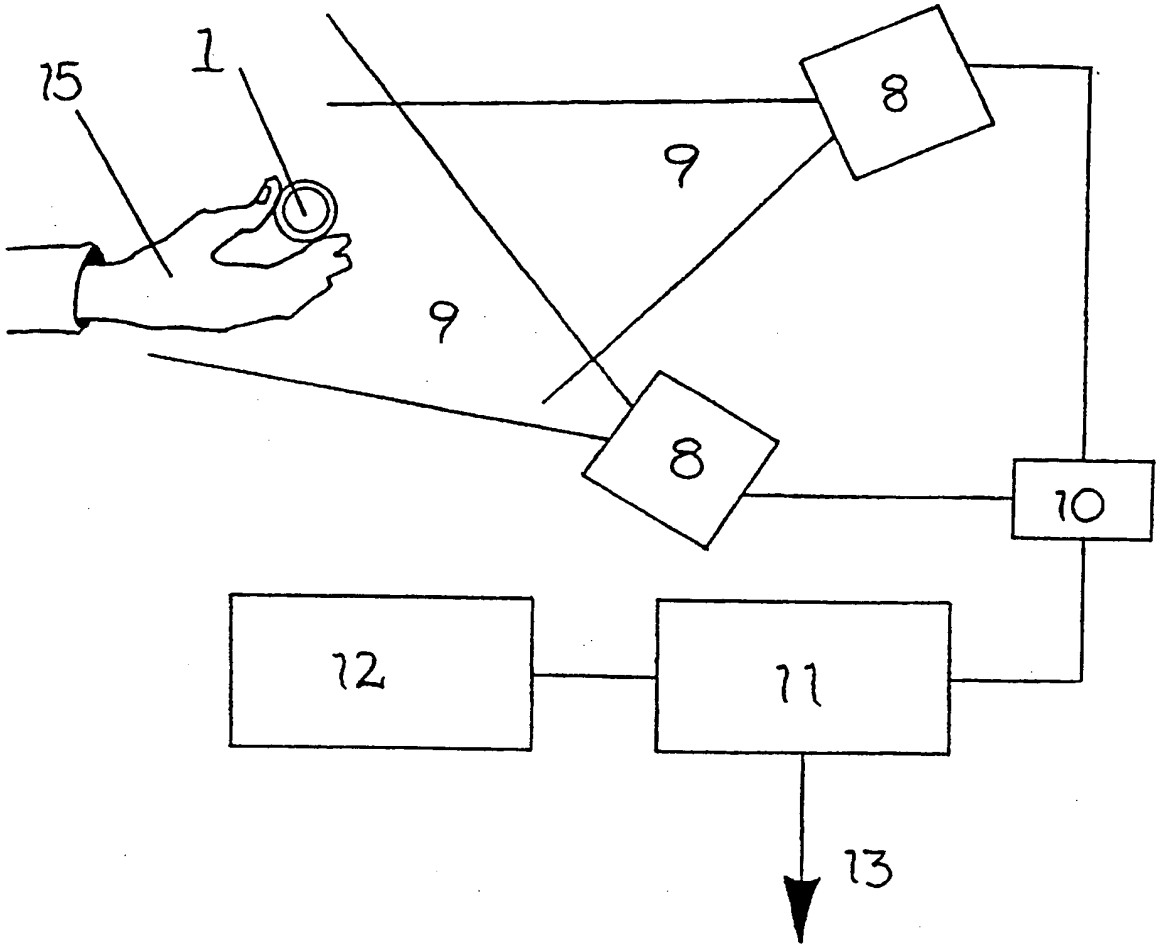

Figure 3

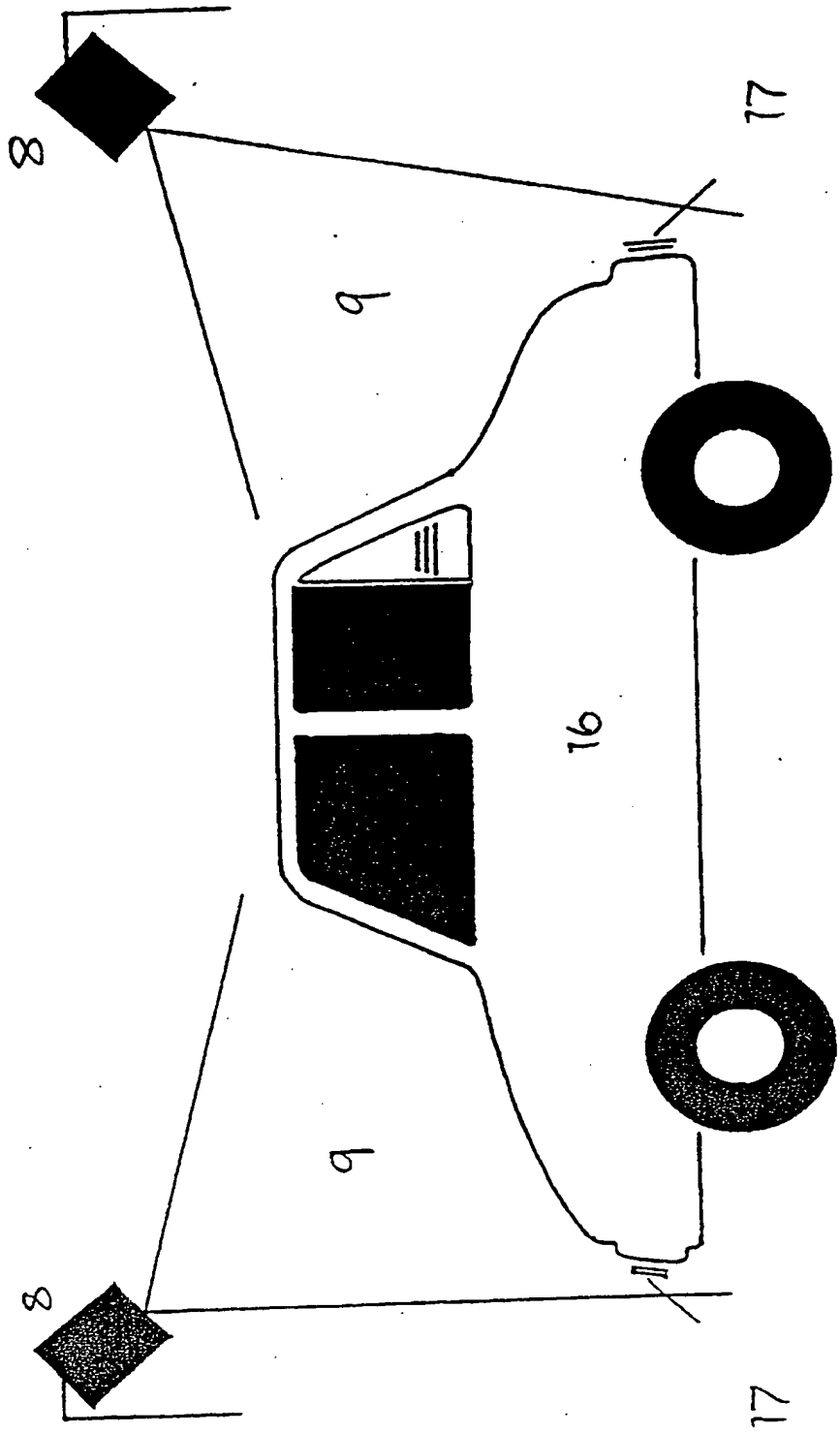

Figure 4

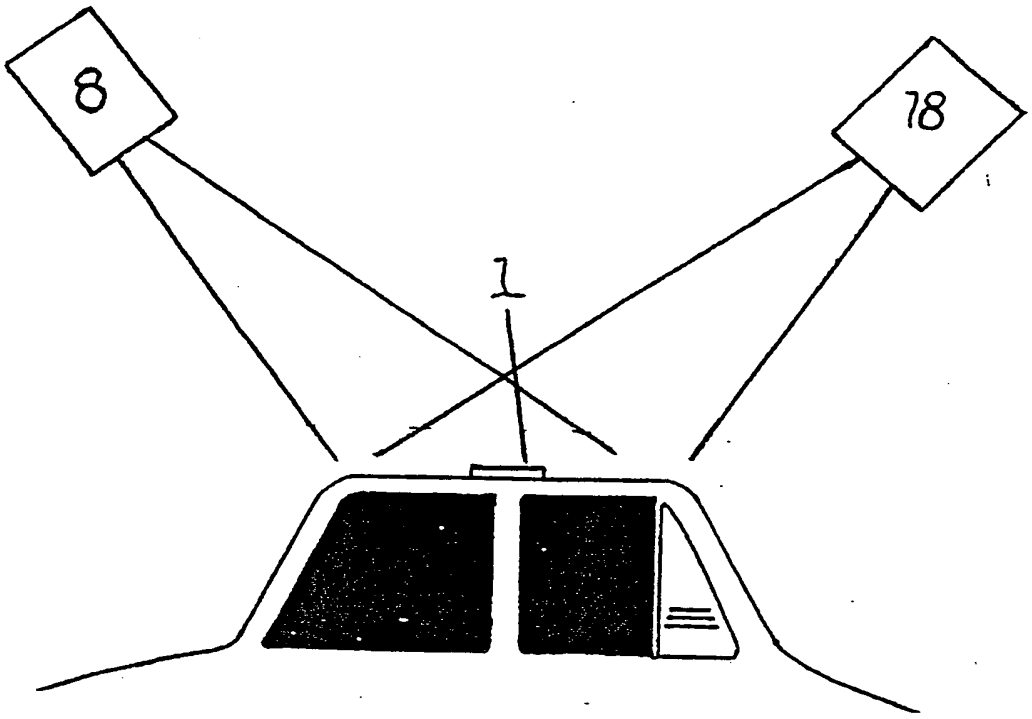

Figure 5

INTERNATIONAL SEARCH REPORT

International Application No. PCT/AU 90/00215

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) 6

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[5] G06K 9/78, G07B 15/00, G07C 9/00

II. FIELDS SEARCHED

Minimum Documentation Searched 7

Classification System	Classification Symbols
IPC	G06K 9/78, 9/00, G07B 15/00, G07C 9/00
US Cl.	235/384, 340/928

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched 8

AU : IPC as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT 9

Category*	Citation of Document, 11 with indication, where appropriate, of the relevant passages 12	Relevant to Claim No 13
P,A,	GB,A, 2219881 (ENGLISH ELECTRIC VALVE COMPANY LIMITED) 20 December 1989 (20.12.89). See the whole document, especially page 1, line 19 to page 2, line 5; also page 8, lines 5 to 7.	(1-10)
A	EP,A, 298343 (COMPAGNIE GENERALE D'AUTOMATISME CGA-HBS) 11 January 1989 (11.01.89). See column 1, line 44 to column 2, line 32.	(1-10)
A	US,A, 4555618 (RISKIN) 26 November 1985 (26.11.85). See column 1, line 59 to column 2, line 19; column 3, line 20 to line 68.	(1-10)

* Special categories of cited documents: 10

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
15 August 1990 (15.08.90)	23 August 1990
International Searching Authority	Signature of Authorized Officer
Australian Patent Office	B. CLARKSON

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON
INTERNATIONAL APPLICATION NO. PCT/AU 90/00215

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report	Patent Family Members			
GB 2219881	EP 347090			
EP 298343	FR 2617309	JP 1033698	US 4908500	

END OF ANNEX